CLAIMS

What is claimed is:

1. A communication system having a spreader for spreading a data signal comprising at least a plurality of data symbols; the system assigning at least one of a plurality of spreading codes where at least one of said plurality of spreading codes is complex, the spreader characterized by:

a data input for receiving said data symbol;

a control input, for receiving an assigned spreading factor for the data signal;

a processor for defining a group of symbols for spreading based upon said assigned spreading factor;

an intermediate code generator for computing a spreading code based upon said assigned spreading factor and at least one code from a plurality of real codes derived from said plurality of assigned spreading codes, said intermediate code generator outputting an intermediate code; and

a rotator for performing a phase rotation of each symbol in said group to generate a complex quantity, said complex quantity being spread with said intermediate code and output as a spread data signal.

2. The system of claim 1 wherein said group N processor defines said group using the relationship:

$$N = \frac{SF_{\max}}{SF}$$

where N denotes the number of data symbols in said group, SF_{max} denotes the maximum spreading factor of the communication system and SF is the assigned spreading factor of the data signal.

3. The system of claim 2 wherein the amount of said phase rotation performed by said rotator is dependent upon the total number of assigned spreading codes.

4. The system of claim 2 wherein said plurality of assigned spreading codes is further characterized by both channelization codes and scrambling codes.

5. The system of claim 4 further characterized by said channelization codes including complex and real codes and said scrambling codes including complex and real codes.

6. The system of claim 5 wherein the amount of said phase rotation by said rotator is dependent upon the total number of complex channelization and complex scrambling codes assigned.

7. The system of claim 6 wherein said phase rotation is further characterized by $j^{(\textit{total number of complex codes})\text{modulo } 4}$ where a remainder of 0 results in 0 degrees of rotation, a remainder of 1 results in 90 degrees of rotation, a remainder of 2 results in 180 degrees of rotation and a remainder of 3 results in 270 degrees of rotation.

8. A spreader (17) that spreads a plurality of data signals ($\underline{d}^k$) in a communication system for transmission assigning at least one of a plurality of spreading codes ($\left(\underline{\tilde{c}}_1 \cdots \underline{\tilde{c}}_{M_1}, \underline{c}_{M_1+1} \cdots \underline{c}_M\right)$ and $\left(\underline{\tilde{v}}_1 \cdots \underline{\tilde{v}}_{P_1}, \underline{v}_{P_1+1} \cdots \underline{v}_P\right)$) for each data signal ($\underline{d}$) where at least one of the assigned spreading codes for each data signal ($\underline{d}$) from the plurality of spreading codes is complex, the spreader (17) characterized by:

a plurality of data inputs for receiving symbols ($\underline{d}_i$) of the respective data signals ($\underline{d}^{(k)}$);

a plurality of processors (19) each coupled to a respective data input, for recovering an assigned spreading factor and for defining a group N of symbols ($\underline{d}_i$) for spreading based upon said spreading factor SF;

a plurality of intermediate code $\underline{s}$ generators (21) for computing one spreading code $\underline{s}$ based upon said assigned spreading factor SF and at least one assigned code ($\underline{d}$) from a plurality of real codes ($\left(\underline{c}_1 \cdots \underline{c}_{M_1}, \underline{c}_{M_1+1} \cdots \underline{c}_M\right)$ and $\left(\underline{v}_1 \cdots \underline{v}_{P_1}, \underline{v}_{P_1+1} \cdots \underline{v}_P\right)$) corresponding to the plurality of codes ($\left(\underline{\tilde{c}}_1 \cdots \underline{\tilde{c}}_{M_1}, \underline{c}_{M_1+1} \cdots \underline{c}_M\right)$ and $\left(\underline{\tilde{v}}_1 \cdots \underline{\tilde{v}}_{P_1}, \underline{v}_{P_1+1} \cdots \underline{v}_P\right)$) for a respective data signal, each said intermediate code $\underline{s}$ generator outputting an intermediate code;

plurality of rotators (25), each coupled to a respective output of a processor (19), for performing a phase rotation of each said data input symbol ($\underline{d}_i$) in said respective group N arriving at a complex quantity ($\underline{\tilde{d}}_{i,\,\mathrm{real}}[n]$, $\underline{\tilde{d}}_{i,\,\mathrm{imag}}[n]$), each said data signal ($\underline{d}$) complex group N quantity ($\underline{\tilde{d}}_{i,\,\mathrm{real}}[n]$, $\underline{\tilde{d}}_{i,\,\mathrm{imag}}[n]$) spread with said respective data signal ($\underline{d}$) intermediate code $\underline{s}$ and output as a spread data signal ($\underline{\tilde{z}}$) for said respective data signal($\underline{d}$); and

a summer (29) for combining all said spread data signals ($\underline{\tilde{z}}$) into a combined spread signal ($\underline{\tilde{z}}^{(\Sigma)}$) as an output.

9. The spreader (17) according to claim 8 wherein each said processor (19) defines a group N using the relationship,

$$N = \frac{SF_{\max}}{SF}$$

where N denotes the number of data symbols in said group N, SF_{max} denotes the maximum spreading factor of the communication system and SF is the assigned spreading factor of the respective data signal.

10. The spreader (17) according to claim 9 wherein the amount of said phase rotation performed by said rotator for each said respective data signal ($\underline{d}$) is dependent upon the total number of complex spreading codes assigned for said respective data signal($\underline{d}$).

11. The spreader (17) according to claim 10 whereby said plurality of assigned spreading codes is further characterized by channelization codes ($\underline{\tilde{c}}_1 \cdots \underline{\tilde{c}}_{M_1}, \underline{c}_{M_{1+1}} \cdots \underline{c}_M$) and scrambling codes ($\underline{\tilde{v}}_1 \cdots \underline{\tilde{v}}_{P_1}, \underline{v}_{P_{1+1}} \cdots \underline{v}_P$).

12. The spreader (17) according to claim 11, whereby said channelization codes ($\underline{\tilde{c}}_1 \cdots \underline{\tilde{c}}_{M_1}, \underline{c}_{M_{1+1}} \cdots \underline{c}_M$) further include complex and real portions and said scrambling codes ($\underline{\tilde{v}}_1 \cdots \underline{\tilde{v}}_{P_1}, \underline{v}_{P_{1+1}} \cdots \underline{v}_P$) including complex and real portions.

13. The spreader (17) according to claim 12 wherein the amount of said phase rotation performed by said rotator for each said respective data signal ($\underline{d}$) is dependent upon said total number of complex channelization and complex scrambling codes.

14. A method of spreading a data signal comprising a plurality of data symbols for transmission in a communication system assigning at least one of a plurality of spreading codes, where at least one of the assigned spreading codes from the plurality of spreading codes is complex, the method characterized by the steps of:

(a) computing a spreading factor;

(b) defining a group of said symbols for spreading based upon said spreading factor;

(c) generating a plurality of real codes corresponding to said plurality of spreading codes;

(d) generating an intermediate code based upon said spreading factor and at least one of said real codes;

(e) rotating each of said symbols of said group to generate a complex spreading code; and

(f) mixing said complex spreading code with said intermediate code to generate an output spreading code.

15. The method according to claim 14 wherein said defining step is further characterized by the step of deriving the size of said group using the formula:

$$N = \frac{SF_{\max}}{SF}$$

where N denotes the number of data symbols in a group, SF_{max} denotes the maximum spreading factor of the communication system and SF is the computed spreading factor.

16. The method according to claim 15 wherein said rotating step is further characterized by differing degrees of rotation in dependence upon the number of complex spreading codes from said assigned codes.

17. The method according to claim 16 wherein said rotating step is further characterized by the steps of:

(d1) rotating 0 degrees when $j^{(\textit{total number of complex codes})\text{modulo } 4}$ remainder is 1;

(d2) rotating 90 degrees when $j^{(\textit{total number of complex codes})\text{modulo } 4}$ remainder is j;

(d3) rotating 180 degrees when $j^{(\textit{total number of complex codes})\text{modulo } 4}$ remainder is 1; and

(d4) rotating 270 degrees when $j^{(\textit{total number of complex codes})\text{modulo } 4}$ remainder is j.

18. The method according to claim 17 whereby said plurality of signal spreading codes is further characterized by channelization codes and scrambling codes.

19. The method according to claim 18 whereby said characterization codes further including complex channelization codes and said scrambling codes further include complex scrambling codes.

20. The method according to claim 19 further characterized by the step of summing said number of complex channelization codes and complex scrambling codes from said assigned codes.